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# **A Unique Mobile High-Energy X-Ray System for Detecting Contraband in Trucks and Cargo Containers**

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# **A Unique Mobile High-Energy X-Ray System for Detecting Contraband in Trucks and Cargo Containers**

## **Abstract**

**X-ray imaging is the primary means of nonintrusive inspection employed to promote security and protect our forces. In addition, x-ray inspection is increasingly being introduced at ports of entry, both home and abroad, for contraband detection and for combating duty fraud. This paper discusses the Eagle, a new mobile self-contained high-energy x-ray imaging system for inspecting cargo containers and vehicles. Overall, the Eagle provides comparable penetration and much higher inspection rates than the fixed-site alternatives at only a fraction of their capital and operating costs. A number of images showing hidden contraband obtained during operational testing will be presented. In addition, the results of early tests of the “Inspection AIDE” will be discussed. This novel contraband detection approach uses x-ray-produced photoneutrons to screen cargo for specific threat materials such as explosives. The Inspection AIDE complements x-ray inspections and is being designed to be deployed as an option to the Eagle.**

# **Inspection System Objectives**

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- **High Penetration:** Inspect large, densely packed containers
- **High Resolution/  
Dynamic Range:** Provide high probability of detection
- **High Speed:** Throughput & fewer systems
- **High Flexibility:** Transportable; rapid set-up; minimal infrastructure
- **Elemental ID:** Discriminate contraband
- **Low Total Cost:** Capital; operational; opportunity



# Inspection Threats

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- **Counterdrug**
  - **Drugs**
  - **Currency**
- **Counterterrorism and Force Protection**
  - **Weapons**
  - **Explosives**
  - **Nuclear Materials**
  - **Chem/Bio Materials**
- **Stolen Articles**
  - **Cars**
  - **Computers**
  - **Electronic Components**
- **Manifest Verification**
- **Antiquities and Endangered Species**

# **Primary Nonintrusive Inspection Options**

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## **X-Ray Systems**

- **Fixed-Site Systems**
  - **Low Energy**
  - **High Energy**
- **Mobile Systems**
  - **Low Energy**
  - **High Energy**

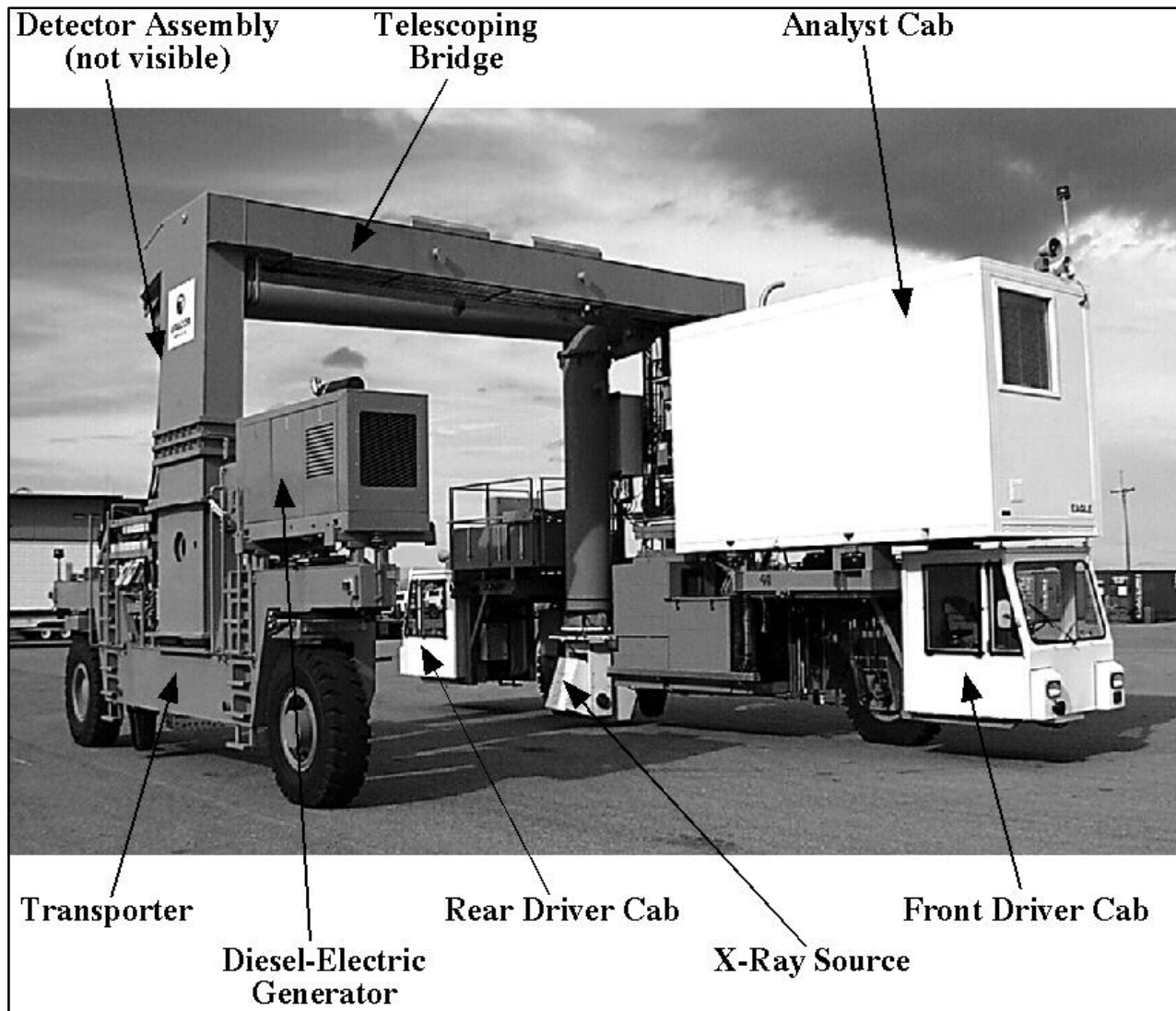
## **Neutron Systems**

- **Thermal Neutron Analysis (TNA)**
- **Pulsed Fast Neutron Analysis (PFNA)**

## **Combined X-Ray and Neutron Systems**

# The Eagle Mobile X-Ray System

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# The Eagle with Shielding System

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# **Eagle Performance Profile**

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**Penetration:** Greater than 12 in. of steel.

**Resolution:** Better than 0.5 inches.

**Inspection Rate:** 0.5 mph nominal; 20-ft. containers in 27 secs.

**Flexibility:** Transportable by truck, ship, or rail.

**No Facility Required:** Does not need dedicated space or infrastructure.

**Safety:** Mechanical & speed interlocks; “cabinet x-ray system.”



# Inspection AIDE

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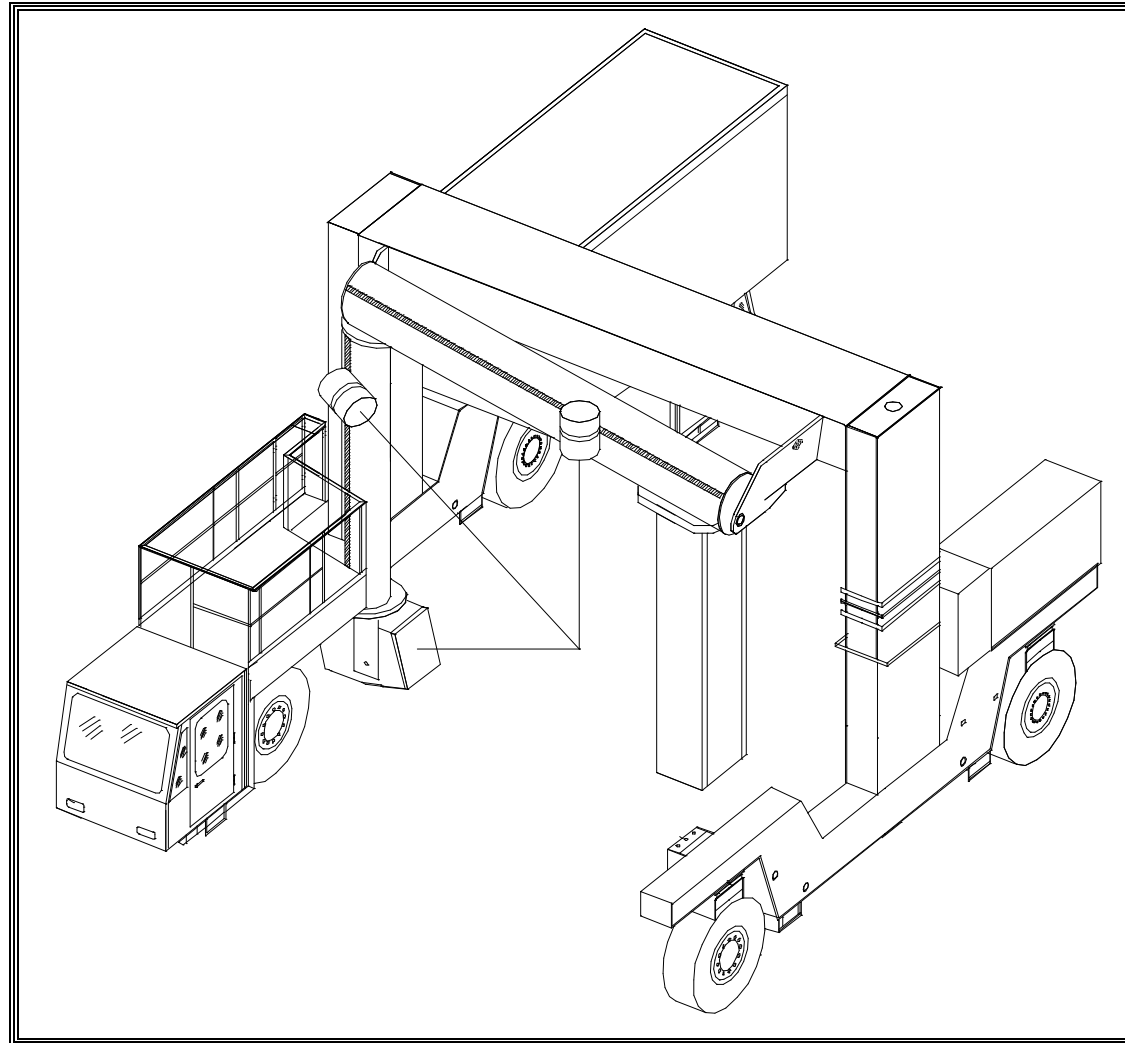
**Inspection AIDE is an analyzer for the identification of drugs and explosives that uses x rays to produce a beam of photoneutrons, which enables the detection of elements present in various threat materials.**

- **Rapid x-ray exam of cargo container/truck.**
- **X-ray beam aligned on suspicious mass.**
- **X-ray beam converted to pulsed neutron beam.**
- **Neutrons propagate into container.**
- **Mass absorbs neutrons and emits gamma rays.**
- **Gamma rays analyzed to reveal likelihood of contraband.**

# Eagle with Inspection AIDE

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# **Eagle vs Inspection Objectives**

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**High Penetration:**      **Greater than 12 inches of steel.**

**High Resolution:**      **Better than 0.5 inches.**

**High Dynamic Range:**      **True 16-bit depth of data.**

**High Speed:**      **20-ft. containers in less than 30 seconds.**

## **Eagle vs Inspection Objectives (cont.)**

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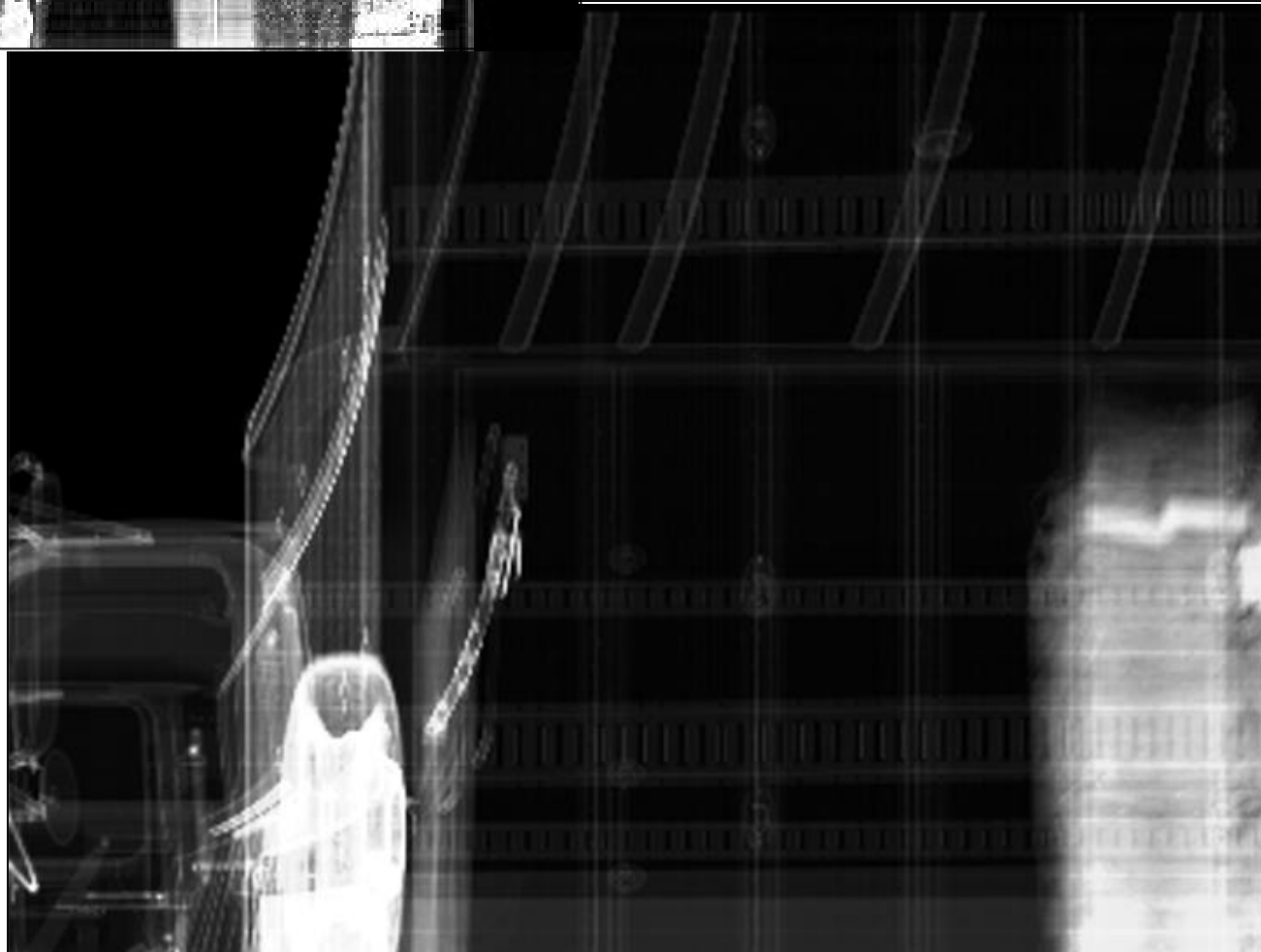
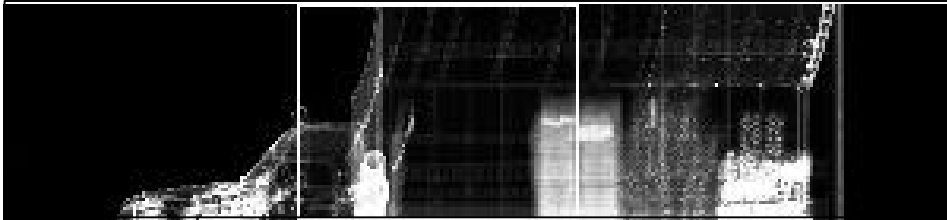


- |                                      |  |
|--------------------------------------|--|
| <b>High Flexibility:</b>             | <b>Driven to adjacent terminals;<br/>Readily disassembled and<br/>shipped by truck, ship, or rail.</b>                                 |
| <b>Elemental<br/>Identification:</b> | <b>Inspection AIDE can screen<br/>for explosives and drugs.</b>  |
| <b>Low Total Cost:</b>               | <b>Much lower capital and<br/>operational cost than fixed-<br/>site systems; requires no<br/>dedicated land or<br/>infrastructure.</b> |

# Truck Inspection

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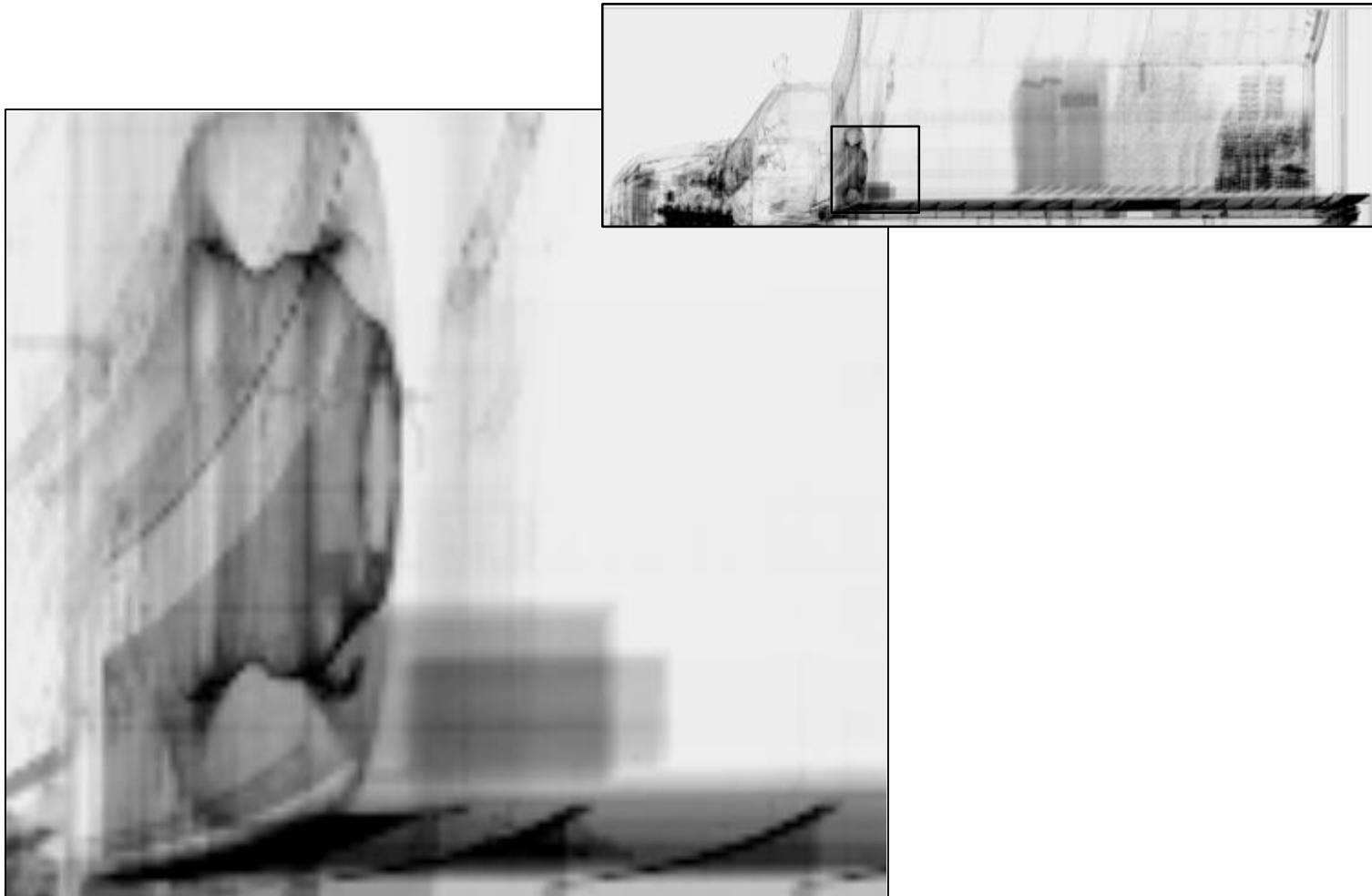
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# Plastic Explosive Simulant

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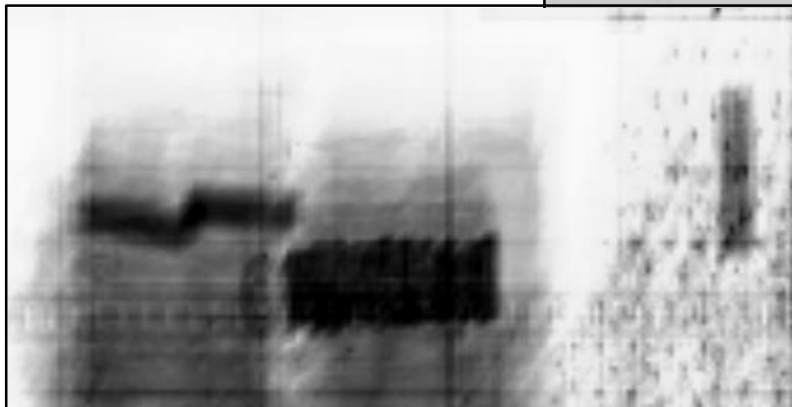
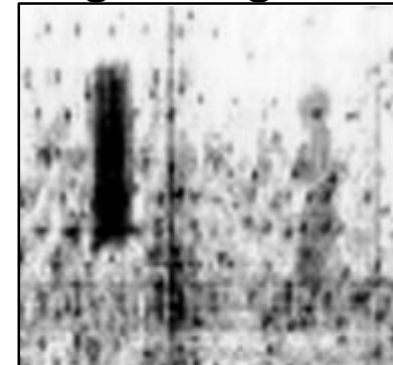
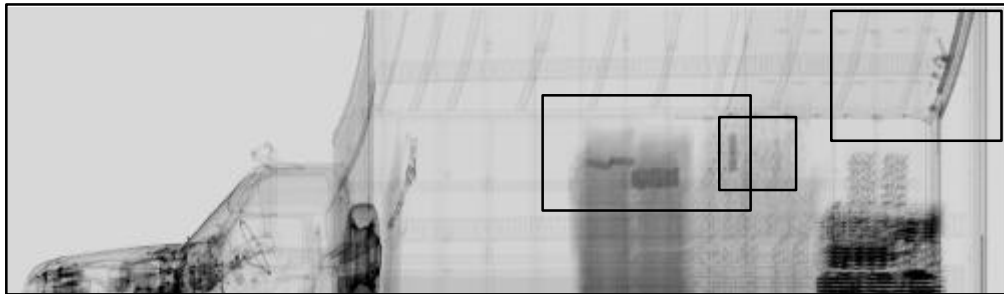
# Truck with Contraband

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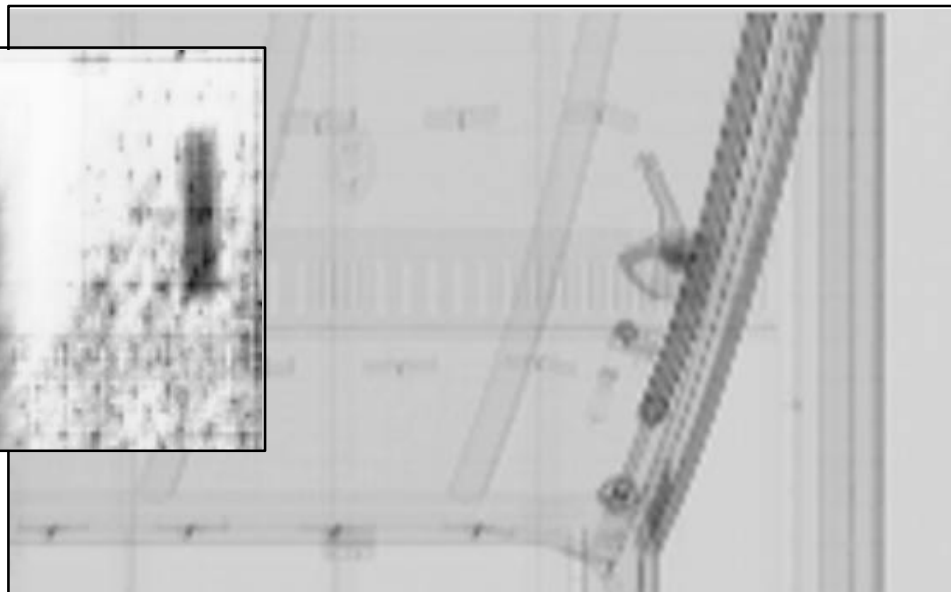
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**Sticks of explosive and 2 Zip bag of 500 gm drug simulant**



**Sticks of plastic explosive**

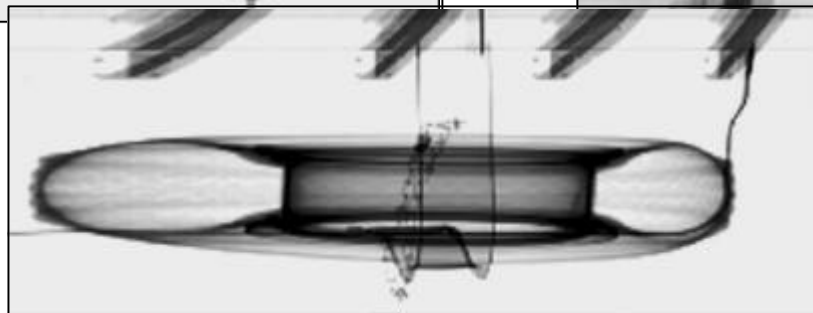
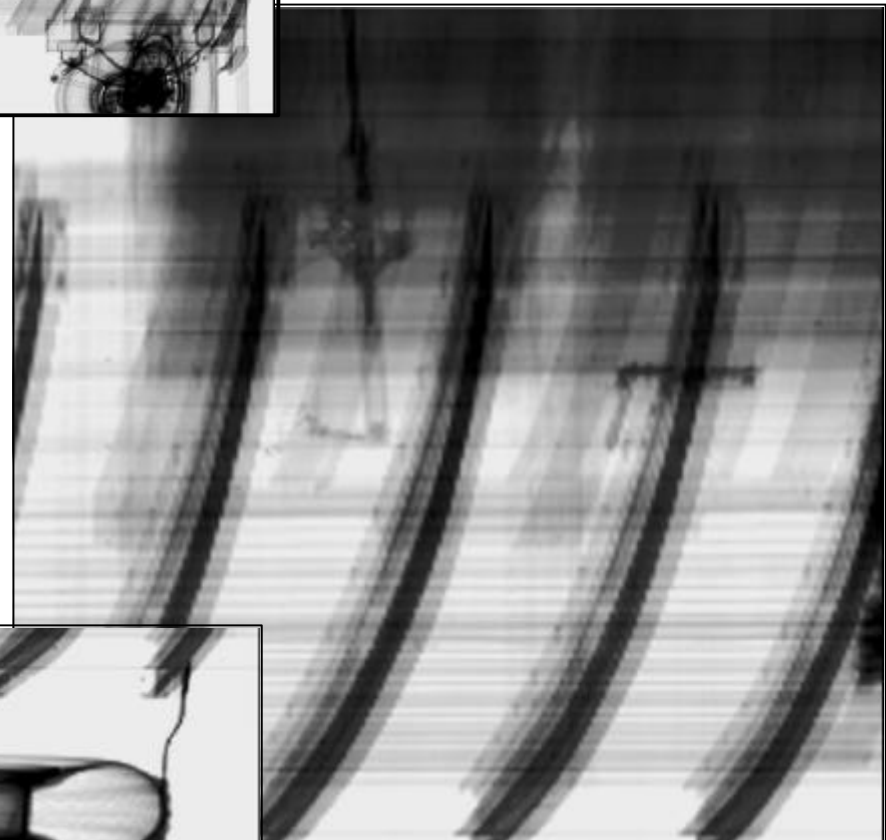
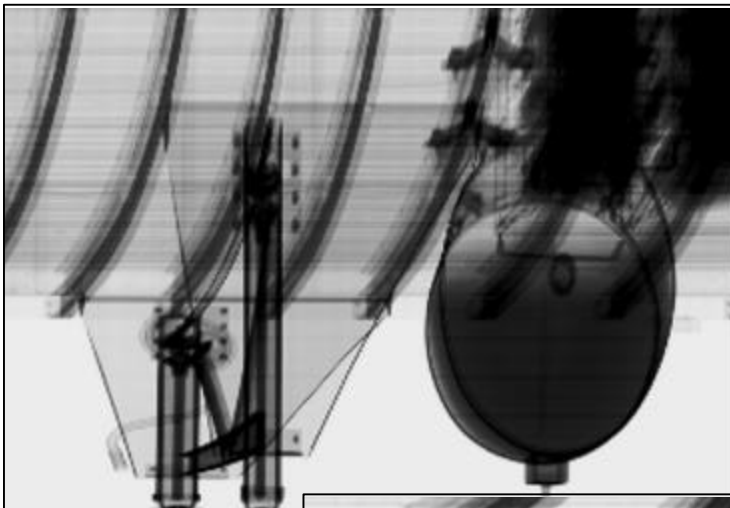
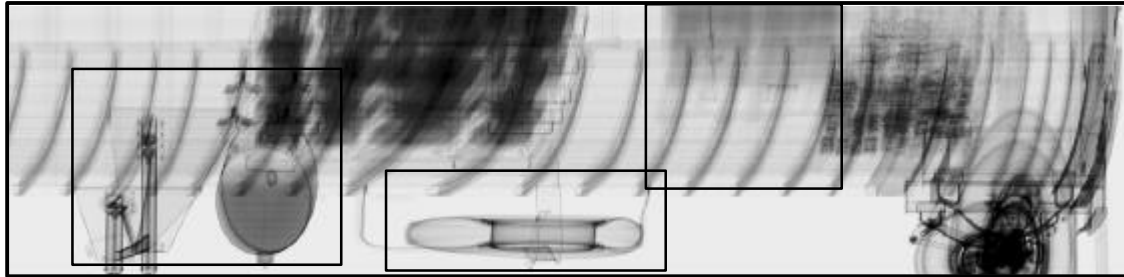


**Hinge and handle lock**

# Truck Inspection

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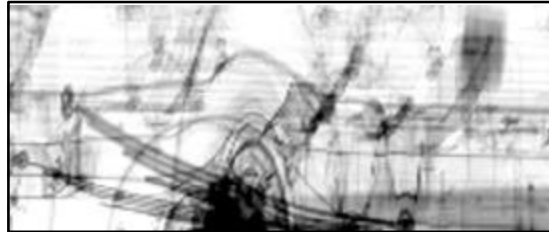




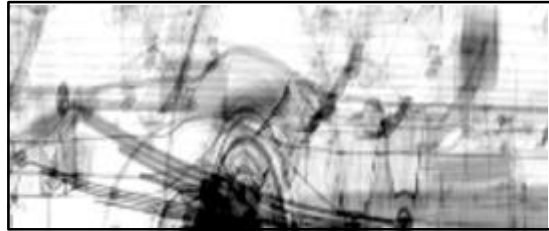
# Use of an Image Data Base

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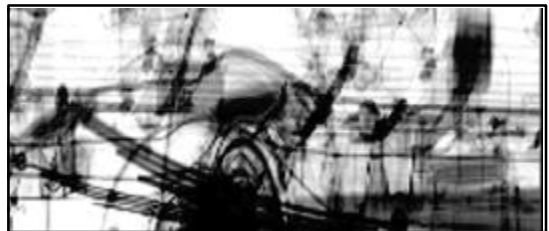
**Empty truck scan  
from database.**



**Truck with 4 packs of C4  
simulant scanned later.**



**Image shows the middle  
image minus the top image.  
This technique highlights the  
locations of the C4 simulant.**



**C4 simulant is shown  
with high lighted region.**